Engine Performance Troubleshooting Tree - ISX15 CM2250

This troubleshooting procedure should be followed for the following symptoms:

- Engine Acceleration or Response Poor
- Engine Difficult to Start or Will **Not** Start
- Engine Power Output Low
- Engine Runs Rough at Idle
- Engine Runs Rough or Misfires
- Engine Speed Surges at Low or High Idle
- Engine Speed Surges under Load or in Operating Range
- Smoke, Black - Excessive
- Smoke, White - Excessive
- Engine Shuts Off or Dies Unexpectedly or Dies During Deceleration
- Engine Decelerates Slowly
- Engine Starts but Will **Not** Keep Running
- Engine Will **Not** Reach Rated Speed (rpm)
- Intake Manifold Pressure (Boost) is Below Normal
- Engine Out NOx Emissions Above Normal (High Diesel Exhaust Fluid (DEF) Consumption)

How to Use This Troubleshooting Procedure:

This symptom tree can be used to troubleshoot all performance-based symptoms listed above. Start by performing Step 1, basic troubleshooting procedures. Step 2 will ask a series of questions and will provide a list of troubleshooting steps to perform, depending on the symptom. Perform the list of troubleshooting in the sequence shown in the Specifications/ Repair section of the tree.

Many steps will reference using an electronic service tool to check for fault codes, perform tests, monitor data, and check features and parameters. It is recommended that the electronic service tool remain connected while using this troubleshooting tree to periodically check for fault codes. If any fault codes become active during use of the troubleshooting tree, discontinue using this troubleshooting tree and troubleshoot the active fault code.

Shop Talk:

Verify the electronic control module (ECM) calibration is correct. Check the calibration revision history found on QuickServe™ Online for applicable fixes to the calibration stored in the ECM. If necessary, calibrate the ECM. Refer to Procedure 019-032 in Section 19.

Driveability is a term that generally describes vehicle performance on the road. Driveability problems for an engine can be caused by several different factors. Some of the factors are engine-related and some are **not**. Before troubleshooting, it is important to determine the exact complaint and whether the engine has a real driveability problem or if it simply does **not** meet driver expectations.

Low power is a term that is used in the field to describe many different performance problems. Low power is defined as the inability of the engine to produce the power necessary to move the vehicle at a speed that can be reasonably expected under the given conditions of load, grade, wind, etc.

Poor acceleration or response is described as the inability of the vehicle to accelerate satisfactorily from a stop or from the bottom of a grade. It can also be the lag in acceleration during an attempt to pass or overtake another vehicle at conditions less than rated speed and load. Poor acceleration or response is difficult to troubleshoot since it can be caused by several factors.

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TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	Perform basic troubleshooting procedures.		
STEP 1A:	Check for active fault codes or high counts of inactive fault codes.	Active fault codes or high counts of inactive fault codes?	
STEP 1B:	Perform basic troubleshooting checks.	All steps have been verified to be correct?	
STEP 1C:	Perform electronic service tool Engine Operating State or User Fueling State monitor test.	Is "Engine Operating State" or "User Fueling State" reading a value that can cause an engine derate?	
STEP 1D:	Check if an ECM calibration update is available.	Is there a calibration update that corrects the issue?	
STEP 1E:	Check engine temperature sensors for accuracy.	Are all temperature readings within 5.5°C [10°F] of each other?	
STEP 1F:	Check ambient/barometric air pressure sensor accuracy.	Is the ambient/barometric air pressure sensor reading within 7 kPa [2 in Hg] of local barometric air pressure?	
STEP 1G:	Verify accelerator pedal travel with an electronic service tool.	Does the accelerator pedal position read 0 percent when the accelerator pedal is released and 100 percent when the accelerator pedal is depressed?	
STEP 1H:	Monitor vehicle speed with an electronic service tool.	Does the vehicle speed read 0 when the vehicle is not moving?	
STEP 2:	Determination of engine symptoms.		
STEP 2A:	Engine Difficult to Start or Will Not Start, Engine Shuts Off or Dies Unexpectedly or Dies During Deceleration, or Engine Starts but Will Not Keep Running.	Is the engine symptom Engine Difficult to Start or Will Not Start, Engine Shuts Off or Dies Unexpectedly or Dies During Deceleration, or Engine Starts but Will Not Keep Running?	
STEP 2B:	Engine Runs Rough at Idle, Engine Runs Rough or Misfires, Engine Speed Surges at Low or High Idle, Engine Speed Surges under Load or in Operating Range.	Is the engine symptom Engine Runs Rough at Idle, Engine Runs Rough or Misfires, Engine Speed Surges at Low or High Idle, Engine Speed Surges under Load or in Operating Range?	
STEP 2B-1:	Verify injector trim codes are correct.	Can the symptom be attributed to incorrect injector trim codes?	
STEP 2B-2:	Perform a single cylinder cutout diagnostic test.	Can the symptom be attributed to a single or multiple cylinders?	
STEP 2C:	Engine Acceleration or Response Poor, Engine Power Output Low, Engine Decelerates Slowly, Intake Manifold Pressure (Boost) is Below Normal, or Engine Will Not Reach Rated Speed (rpm).	Is the engine symptom Engine Acceleration or Response Poor, Engine Power Output Low, Engine Decelerates Slowly, Intake Manifold Pressure (Boost) is Below Normal, Engine Will Not Reach Rated Speed (rpm), or Engine Out NOx Emissions Above Normal (High DEF Consumption)?	

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STEP 2D:	Smoke, Black - Excessive.	Is there excessive black smoke during acceleration or constant black smoke at high idle?
STEP 2E:	Smoke, White - Excessive.	Is the engine symptom Smoke, White - Excessive?
STEP 2E-1:	Check for engine coolant consumption.	Is the engine using coolant?
STEP 2E-2:	Verify engine operating conditions when the white smoke complaint occurs.	Does the white smoke complaint occur during an automatic or stationary regeneration?
STEP 2E-3:	Verify ambient conditions when excessive white smoke complaint occurs.	Is the white smoke excessive complaint only occurring when the engine is cold and during cold ambient conditions?

STEP 3: Engine will Not Start, Difficult to Start, or Stalls.

STEP 3A:	Verify the type of engine starting complaint.	Is the engine starting complaint that the engine is difficult to start after an overnight shutdown?
STEP 3A-1:	Verify the OEM fuel drain line is routed correctly.	Is the OEM fuel drain line routed correctly?
STEP 3B:	Verify the installation and operation of cold weather starting aids.	Are the necessary cold weather starting aids installed and operating properly?
STEP 3C:	Check electronic features and programmable parameters.	Are electronic features and parameters the cause for the engine shutting down or engine no start complaint?
STEP 3D:	Check engine speed (rpm) during cranking.	Is the engine speed greater than 150 rpm during cranking?
STEP 3E:	Monitor the ECM keyswitch input.	Does the User Fueling State indicate "Cranking" and/or is the keyswitch voltage equal to battery voltage?
STEP 3F:	Monitor the ECM battery supply.	Is the ECM battery supply voltage greater than 11-VDC?
STEP 3G:	Check the load carrying capabilities of the ECM power and ground circuits.	Does the headlight illuminate brightly?
STEP 3H:	Monitor the fuel rail pressure sensor value while cranking the engine.	Did Fault Code 559 become active during the unsuccessful start attempt?

STEP 4: Fuel system checks.

STEP 4A:	Check for air entering the fuel system.	Is air present in the fuel system?
STEP 4B:	Measure the fuel inlet restriction.	Is the fuel inlet restriction within specification?
STEP 4C:	Measure the lift pump fuel flow.	Is the fuel pressure greater than specification?
STEP 4D:	Measure the fuel pressure at the inlet to the pressure side fuel filter.	Is the pressure measured greater than the specification?
STEP 4E:	Measure the fuel pressure at the outlet of the pressure side fuel filter.	Is the fuel pressure drop across the filter greater than the specification?

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STEP 4F:	Measure the injector fuel drain flow.	Is injector fuel drain flow from the cylinder head greater than specification?
STEP 4G:	Monitor Commanded Fuel Rail Pressure and Measured Fuel Rail Pressure.	Does the Measured Fuel Rail Pressure vary more than ± 35 bar [± 500 psi] from the Commanded Fuel Rail Pressure?
STEP 4H:	Check the fuel pressure relief valve for excessive leakage.	Is the fuel pressure relief valve within specification?
STEP 4I:	Measure the fuel pump head drain flow.	Is the high pressure fuel pump head drain flow greater than specification?
STEP 4J:	Check the fuel drain line restriction.	Is the drain line restriction greater than specification?

STEP 5: Air handling checks.

STEP 5A:	Check the air intake system for leaks.	Were any air intake system leaks found?
STEP 5B:	Check air intake restriction.	Is the air intake restriction greater than the specification?
STEP 5C:	Inspect charge-air cooler.	Were any problems found with the charge-air cooler?
STEP 5D:	Inspect the turbocharger shaft movement.	Does the nozzle slide evenly from stop to stop and are the gear teeth undamaged?
STEP 5E:	Inspect the turbocharger blades for damage or fouling.	Damage or fouling found on the turbocharger fins?
STEP 5F:	Measure turbocharger axial and radial clearance.	Were the radial and axial clearances within specification?

STEP 6: EGR system checks.

STEP 6A:	Check for leaks in the EGR system.	Were air leaks found in the EGR connection tubing?
STEP 6B:	Check the EGR differential pressure sensor for proper operation.	Is the EGR differential pressure greater than 1.5 kPa [0.22 psi] when the EGR valve is open greater than 50 percent?
STEP 6C:	Check the EGR system for blockage.	Was blockage or excessive carbon buildup found in the EGR valve differential pressure sensor and/or intake connection passages?
STEP 6D:	Check the EGR valve for blockage and/or damage.	Is the EGR valve blocked and/or damaged?
STEP 6E:	Check the exhaust gas pressure sensor plumbing for blockage.	Was there blockage in the exhaust pressure sensor plumbing?

STEP 7: Verify electronic features are operating correctly.

STEP 7A:	Verify the electronic feature settings are correct.	Were the electronic features set correctly?

STEP 8: Perform base engine mechanical checks.

STEP 8A:	Verify the symptom is "Engine will not start".	Does the engine start and run?

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STEP 8B:	Verify overhead adjustments are correct.	Were the overhead settings within the reset limits?
STEP 8C:	Check engine blowby (crankcase pressure).	Is the blowby (crankcase pressure) greater than specification?
STEP 8D:	Check for internal engine damage.	Did cutting the oil filter open reveal evidence of internal engine damage?

STEP 9: Perform exhaust system checks.

STEP 9A:	Inspect the exhaust system.	Were any exhaust leaks found in the exhaust system?
STEP 9B:	Check the exhaust restriction.	Is the exhaust restriction greater than specification?
STEP 9C:	Check exhaust restriction after the aftertreatment diesel particulate filter.	Is the exhaust restriction greater than specification?

TROUBLESHOOTING STEP

STEP 1: Perform basic troubleshooting procedures.

STEP 1A: Check for active fault codes or high counts of inactive fault codes.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE™ electronic service tool to read the fault codes. • Use the following manual to troubleshoot active fault codes. Refer to the Fault Code Troubleshooting Manual, Bulletin 4022225.	Active fault codes or high counts of inactive fault codes? YES	Appropriate fault code troubleshooting tree
	Active fault codes or high counts of inactive fault codes? NO	1B

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STEP 1B: Perform basic troubleshooting checks.

Condition:
N/A

Action	Specification/Repair	Next Step
Check or verify the following items before continuing: • Verify the vehicle is in good working order (brakes, transmission, etc.) • Verify the fuel level in the tanks (do **not** rely on the fuel gauge; physically check for fuel in the fuel tank). • Verify there have **not** been any changes to CPL components on the engine. • Verify fuel grade is correct for application. • Verify the engine is operating within the recommended altitude. • Verify engine oil is at the correct level. • Verify engine parasitics have **not** changed. • Verify engine duty cycle has **not** changed. • Verify the air filter is **not** excessively plugged. • Listen for air and exhaust leaks. • Verify there are no visible external fuel leaks. • Verify there are no visible coolant leaks. • Verify there are no visible signs (soot streaks) of an external EGR leak. • Verify battery voltage is adequate. • Fuel system is primed.	All steps have been verified to be correct? **YES**	1C
	All steps have been verified to be correct? **NO** **Repair:** Correct the condition and verify complaint is no longer present after repair.	Repair complete

STEP 1C: Perform electronic service tool Engine Operating State or User Fueling State monitor test.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Run the engine running at speed and load where the symptom occurs.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor the parameter User Fueling State or Engine Operating State at the same engine operating conditions where the symptom occurs. Refer to Advanced Engine Performance Troubleshooting Techniques, Bulletin 4021686, for a description of what "User Fueling States" or "Engine Operating State" can cause the engine to derate.	Is "Engine Operating State" or "User Fueling State" reading a value that can cause an engine derate? **YES** **Repair:** Determine if the engine derate is being caused by normal engine operation or by an actual engine malfunction. Continue following troubleshooting steps as outlined in Step 2 if an engine malfunction is suspected.	2A
	Is "Engine Operating State" or "User Fueling State" reading a value that can cause an engine derate? **NO**	1D

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STEP 1D: Check if an ECM calibration update is available.

Condition:
N/A

Action	Specification/Repair	Next Step
Verify the ECM calibration is correct. • Check the calibration revision history for applicable fixes to the calibration stored in the ECM. See the calibration history spreadsheet. See the calibration history spreadsheet ecm_calibration_rev_history.xls on QuickServe™ Online or the INCAL™ CD-ROM. • Compare the calibration stored in the ECM with the engine rating and Control Parts List (CPL).	Is there a calibration update that corrects the issue? **YES** **Repair:** If necessary, calibrate the ECM. Refer to Procedure 019-032 in Section 19.	Repair complete
	Is there a calibration update that corrects the issue? **NO**	1E

STEP 1E: Check engine temperature sensors for accuracy.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine **must** be turned off long enough for coolant temperature to be equal to the local air temperature.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor the following temperature sensor values: • Coolant temperature • Ambient air temperature • Intake manifold air temperature • Exhaust gas recirculation (EGR) gas temperature **Note:** Do **not** compare the aftertreatment temperature sensors during this step.	Are all temperature readings within 5.5°C [10°F] of each other? **YES**	1F
	Are all temperature readings within 5.5°C [10°F] of each other? **NO** **Repair:** Check for a short from the signal pin of the temperature sensor in question to all other pins in the harness. Use the following procedure for general resistance measurement techniques. • Refer to Procedure 019-360 in Section 19. If no short is found, replace the temperature sensor that is reading higher or lower than the other sensors. • See Section 19 for specifics on each temperature sensor.	Repair complete

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STEP 1F: Check ambient/barometric air pressure sensor accuracy.

Condition:
- Turn keyswitch ON.
- INSITE™ electronic service tool connected.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor the ambient/barometric air pressure sensor value. Compare the value to the local ambient/ barometric air pressure. • Refer to Procedure 018-028 in Section V.	Is the ambient/barometric air pressure sensor reading within 7 kPa [2 in Hg] of local barometric air pressure? **YES**	1G
	Is the ambient/barometric air pressure sensor reading within 7 kPa [2 in Hg] of local barometric air pressure? **NO** **Repair:** Check for a short from the SIGNAL pin of the barometric/ambient air pressure sensor in question to all other pins in the harness. • Refer to Procedure 019-360 in Section 19. If no short is found, replace the barometric/ ambient air pressure sensor. • Refer to Procedure 019-004 in Section 19.	Repair complete

STEP 1G: Verify accelerator pedal travel with an electronic service tool.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine OFF.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor accelerator position while fully depressing and releasing the accelerator pedal.	Does the accelerator pedal position read 0 percent when the accelerator pedal is released and 100 percent when the accelerator pedal is depressed? **YES**	1H
	Does the accelerator pedal position read 0 percent when the accelerator pedal is released and 100 percent when the accelerator pedal is depressed? **NO** **Repair:** Refer to the OEM service manual for accelerator pedal troubleshooting.	Repair complete

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STEP 1H: Monitor vehicle speed with an electronic service tool.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine OFF.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor vehicle speed while the vehicle is not moving.	Does the vehicle speed read 0 when the vehicle is **not** moving? **YES**	2A
	Does the vehicle speed read zero when the vehicle is **not** moving? **NO** **Repair:** Check the vehicle speed sensor and circuit for problems. • Refer to the OEM service manual.	Repair complete

STEP 2: Determination of engine symptoms.

STEP 2A: Engine Difficult to Start or Will Not Start, Engine Shuts Off or Dies Unexpectedly or Dies During Deceleration, or Engine Starts but Will Not Keep Running.

Condition:
N/A

Action	Specification/Repair	Next Step
Interview the driver and verify the complaint.	Is the engine symptom Engine Difficult to Start or Will **Not** Start, Engine Shuts Off or Dies Unexpectedly or Dies During Deceleration, or Engine Starts but Will **Not** Keep Running? **YES** **Repair:** Perform the troubleshooting steps in the recommended order listed below: • Step 3 - Engine will **not** start, difficult to start, or stalls • Step 4 - Fuel system checks • Step 8 - Base engine checks.	Perform the troubleshooting steps suggested in the repair procedure
	Is the engine symptom Engine Difficult to Start or Will **Not** Start, Engine Shuts Off or Dies Unexpectedly or Dies During Deceleration, or Engine Starts but Will **Not** Keep Running? **NO**	2B

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STEP 2B: Engine Runs Rough at Idle, Engine Runs Rough or Misfires, Engine Speed Surges at Low or High Idle, Engine Speed Surges under Load or in Operating Range.

Condition:
N/A

Action	Specification/Repair	Next Step
Interview the driver and verify the complaint.	Is the engine symptom Engine Runs Rough at Idle, Engine Runs Rough or Misfires, Engine Speed Surges at Low or High Idle, Engine Speed Surges under Load or in Operating Range? **YES**	2B-1
	Is the engine symptom Engine Runs Rough at Idle, Engine Runs Rough or Misfires, Engine Speed Surges at Low or High Idle, Engine Speed Surges under Load or in Operating Range? **NO**	2C

STEP 2B-1: Verify injector trim codes are correct.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to verify the injector trim codes are correct. • Use INSITE™ electronic service tool to connect to the ECM • Select "Features and Parameters" • Select "High Pressure Common Rail Injector Setup" • View the injector trim codes for each cylinder • Verify the trim codes are correct by comparing the installed trim codes with the codes listed in the Engine Data Plate information on QuickServe™ Online. **Note:** The injector trim codes in the Engine Dataplate section of QuickServe™ Online are the original trim codes. Review the claims history for previous injector replacements. If one injector is **not** original, remove the rocker lever cover and read the injector trim codes on each injector solenoid. Refer to Procedure 003-011 in Section 3.	Can the symptom be attributed to incorrect injector trim codes? **YES** **Repair:** Use INSITE™ electronic service tool to adjust the injector trim codes. • Refer to Procedure 006-026 in Section 6.	Repair complete
	Can the symptom be attributed to incorrect injector trim codes? **NO**	2B-2

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STEP 2B-2: Perform a single cylinder cutout diagnostic test.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine running at low idle.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to perform a single cylinder cutout diagnostic test. • Operate the engine under the conditions in which the complaint occurs. • Use the electronic service tool to perform the cylinder cutout test to disable individual injector(s). **Note:** If this test is performed and there is **not** a significant change while cutting out one injector, there may be a problem with more than one injector. It may be necessary to cut out multiple injectors at the same time.	Can the symptom be attributed to a single or multiple cylinders? **YES** **Repair:** • Perform the checks in Step 4F **only**. • If required, perform the checks in Step 4F-1. • Step 8 - Base engine checks.	Repair complete
	Can the symptom be attributed to a single or multiple cylinders? **NO** **Repair:** Perform the troubleshooting steps in the recommended order listed below: • Step 7 - Electronic checks • Step 4 - Fuel system checks • Step 5 - Air handling checks • Step 6 - EGR system checks • Step 8 - Base engine checks.	Perform the troubleshooting steps suggested in the repair procedure

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STEP 2C: Engine Acceleration or Response Poor, Engine Power Output Low, Engine Decelerates Slowly, Intake Manifold Pressure (Boost) is Below Normal, or Engine Will Not Reach Rated Speed (rpm).

Condition:
N/A

Action	Specification/Repair	Next Step
Interview the driver and verify the complaint.	Is the engine symptom Engine Acceleration or Response Poor, Engine Power Output Low, Engine Decelerates Slowly, Intake Manifold Pressure (Boost) is Below Normal, Engine Will **Not** Reach Rated Speed (rpm), or Engine Out NOx Emissions Above Normal (High DEF Consumption)? **YES** **Repair:** Perform the troubleshooting steps in the recommended order listed below: • Step 7 - Electronic checks • Step 6 - EGR system checks • Step 5 - Air handling checks • Step 4 - Fuel system checks • Step 9 - Exhaust system checks • Step 8 - Base engine checks.	Perform the troubleshooting steps suggested in the repair procedure
	Is the engine symptom Engine Acceleration or Response Poor, Engine Power Output Low, Engine Decelerates Slowly, Intake Manifold Pressure (Boost) is Below Normal, Engine Will **Not** Reach Rated Speed (rpm), or Engine Out NOx Emissions Above Normal (High DEF Consumption)? **NO**	2D

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STEP 2D: Smoke, Black - Excessive.

Condition:
- Exhaust pipe disconnected from the aftertreatment inlet.
- Engine running.

Action	Specification/Repair	Next Step
Check the exhaust smoke. • Perform two snap accelerations from low to high idle. Hold the engine at high idle for 5 seconds. • A small puff of black smoke upon acceleration that clears at a steady high idle speed is normal. **Note:** To perform a snap acceleration test, it can be necessary to temporarily adjust the Maximum Engine Speed with No VSS parameter in INSITE™ electronic service tool to the high idle speed of the engine. **Note:** Progressive damage to the aftertreatment system has occurred if black smoke is visible at the exhaust outlet when the aftertreatment diesel particulate filter is installed. Remove the exhaust aftertreatment system from the vehicle and inspect for reuse. Refer to Procedure 014-013 in Section 14.	Is there excessive black smoke during acceleration or constant black smoke at high idle? **YES** **Repair:** Perform the troubleshooting steps in the recommended order listed below: • Step 7 - Electronic checks • Step 6 - EGR system checks • Step 5 - Air handling checks • Step 4 - Fuel system checks • Step 8 - Base engine checks.	Perform the troubleshooting steps suggested in the repair procedure.
	Is there excessive black smoke during acceleration or constant black smoke at high idle? **NO**	2E

STEP 2E: Smoke, White - Excessive.

Condition:
N/A

Action	Specification/Repair	Next Step
Interview the driver and verify the complaint.	Is the engine symptom Smoke, White - Excessive? **YES**	2E-1
	Is the engine symptom Smoke, White - Excessive? **NO**	For engine-related symptoms, see the appropriate troubleshooting symptom tree

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STEP 2E-1: Check for engine coolant consumption.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Interview the driver and verify the complaint. • Verify if coolant is being used, in addition to the white smoke complaint. • Check the coolant level.	Is the engine using coolant? **YES**	See the Coolant Loss - Internal Troubleshooting Symptom Tree
	Is the engine using coolant? **NO**	2E-2

STEP 2E-2: Verify engine operating conditions when the white smoke complaint occurs.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Interview the driver and verify the complaint. • Check if the white smoke complaint occurs while the engine is performing an automatic or stationary regeneration. • Perform a Stationary Regeneration. Refer to Procedure 014-013 in Section 14.	Does the white smoke complaint occur during an automatic or stationary regeneration? **YES** **Repair:** Some white smoke is typical during an automatic or stationary regeneration. Complete a stationary regeneration. • Refer to Procedure 014-013 in Section 14. If there is no strong hydrocarbon odor present at the exhaust outlet, no further troubleshooting is necessary. If a strong hydrocarbon odor is present, no exhaust leaks are present and the Stationary Regeneration completes with no problems, inspect the aftertreatment diesel oxidation catalyst for face plugging, contamination, or other damage. • Refer to Procedure 011-049 in Section 11.	Repair complete
	Does the white smoke complaint occur during an automatic or stationary regeneration? **NO**	2E-3

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STEP 2E-3: Verify ambient conditions when excessive white smoke complaint occurs.

Condition:
N/A

Action	Specification/Repair	Next Step
Interview the driver and verify the complaint. • Check if the white smoke excessive complaint is **only** occurring when the engine is cold and during cold ambient conditions? **Note:** Some white smoke after a cold start and/or extended idle time in cold ambient conditions is **not** uncommon. The aftertreatment diesel particulate filter may retain moisture at low exhaust temperatures. As exhaust temperatures increase during engine operation, the moisture in the aftertreatment diesel particulate filter will be reduced and white smoke will be evident out of the exhaust tailpipe. If white smoke persists after the engine has reached the minimum operating temperature and a strong hydrocarbon odor is still present, troubleshoot the white smoke complaint. Minimum operating coolant temperature: 71°C [160°F]	Is the white smoke excessive complaint **only** occurring when the engine is cold and during cold ambient conditions? **YES** **Repair:** Perform the troubleshooting steps in the recommended order listed below: • Perform the checks in Step 3B **only** • Step 7 - Electronics checks • Step 4 - Fuel system checks • Step 5 - Air handling checks • Step 8 - Base engine checks.	Perform the troubleshooting steps suggested in the repair procedure
	Is the white smoke excessive complaint **only** occurring when the engine is cold and during cold ambient conditions? **NO**	For engine-related symptoms, see the correct troubleshooting symptom tree

STEP 3: Engine will Not Start, Difficult to Start, or Stalls.

STEP 3A: Verify the type of engine starting complaint.

Condition:
N/A

Action	Specification/Repair	Next Step
Interview the driver and verify the complaint. • Verify the type of complaint and when the difficult to start complaint occurs.	Is the engine starting complaint that the engine is difficult to start after an overnight shutdown? **YES**	3A-1
	Is the engine starting complaint that the engine is difficult to start after an overnight shutdown? **NO**	3B

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STEP 3A-1: Verify the OEM fuel drain line is routed correctly.

Condition:
- Turn keyswitch ON.
- Engine being shutdown.

Action	Specification/Repair	Next Step
Verify the OEM fuel drain line is routed correctly to the bottom of the fuel tank. • To help determine if during shutdown, air is being pulled into the fuel system during shutdown or after extended cranking, install a clear fuel line between the engine and OEM fuel drain line connection. • Monitor the line for air during engine shutdown.	Is the OEM fuel drain line routed correctly? **YES**	3B
	Is the OEM fuel drain line routed correctly? **NO** **Repair:** Correct the routing of the fuel drain line. Refer to the OEM service manual.	Repair complete

STEP 3B: Verify the installation and operation of cold weather starting aids.

Condition:
- Engine and ambient conditions cold.

Action	Specification/Repair	Next Step
Make sure the necessary cold weather starting aids are installed and operational: • For information on operation of diesel engines in cold climates, refer to Service Bulletin 3379009.	Are the necessary cold weather starting aids installed and operating properly? **YES**	3C
	Are the necessary cold weather starting aids installed and operating properly? **NO** **Repair:** Install or repair cold weather starting aids.	Repair complete

STEP 3C: Check electronic features and programmable parameters.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the electronic features and parameters. • Check if any enabled electronic features and parameters are the cause of the no start condition. These may include: • Idle Shutdown • Engine Protection Shutdown, or • Vehicle Anti-theft Protection.	Are electronic features and parameters the cause for the engine shutting down or engine no start complaint? **YES** **Repair:** Program the electronic features per the customer or OEM requirements.	Repair complete
	Are electronic features and parameters the cause for the engine shutting down or engine no start complaint? **NO**	3D

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STEP 3D: Check engine speed (rpm) during cranking.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Crank the engine.

Action	Specification/Repair	Next Step
Monitor engine speed with INSITE™ electronic service tool during cranking. • Attempt to start the engine. Engage the engine starter for at least 15 continuous seconds. **Note:** Do **not** overheat the starter. **Note:** Attempting to start the engine for 15 continuous seconds also allows the fault code logic time to run. • If any fault codes become active, stop using this troubleshooting tree and see the corresponding fault code troubleshooting tree. **Note:** In some vehicles, power to the electronic service tool is interrupted during cranking. In this case, it is **not** possible to monitor engine speed during cranking. A photo-tachometer or other device can be used as a substitute.	Is the engine speed greater than 150 rpm during cranking? **YES**	3E
	Is the engine speed greater than 150 rpm during cranking? **NO** **Repair:** Find and correct the cause for low cranking speed; consider batteries, engine starting motor, and accessory loads. • Use the Engine Will **Not** Crank or Cranks Slowly troubleshooting symptom tree.	Repair complete

STEP 3E: Monitor the ECM keyswitch input.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine **not** running.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor User Fueling State and keyswitch while cranking the engine. **Note:** If the engine is intermittently shutting down, User Fueling State can also be monitored during engine shutdown. If an electronic service tool is unavailable: • Disconnect the OEM harness. • Turn the keyswitch ON. Measure the signal voltage from the keyswitch input SIGNAL wire of the OEM harness to the engine block ground. Measure the keyswitch voltage with the keyswitch in the ON position and also with the keyswitch in the cranking position. Refer to the corresponding wiring diagram for connector pin identification.	Does the User Fueling State indicate "Cranking" and/or is the keyswitch voltage equal to battery voltage? **YES**	3F
	Does the User Fueling State indicate "Cranking" and/or is the keyswitch voltage equal to battery voltage? **NO** **Repair:** Check the keyswitch battery supply circuit. • Refer to Procedure 019-064 in Section 19. Repair or replace the OEM harness, keyswitch, or check the battery connections. • Refer to the OEM service manual for the proper procedures.	Repair complete

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STEP 3F: Monitor the ECM battery supply.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine **not** running.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor battery voltage while cranking the engine. If an electronic service tool is unavailable: • Disconnect the ECM power supply connection. • Turn keyswitch ON. Measure the voltage from the ECM battery supply (-) pin(s) to the ECM battery supply (+) pin(s) in the ECM connector. Measure the ECM voltage with the keyswitch in the ON position and also with the keyswitch in the Cranking position. Refer to the wiring diagram for connector pin identification.	Is the ECM battery supply voltage greater than 11-VDC? **YES**	3H
	Is the ECM battery supply voltage greater than 11-VDC? **NO** **Repair:** Determine the cause of the low ECM battery supply voltage. Check the battery connections and fuse terminals. If necessary, repair or replace the ECM power harness. • Refer to the OEM service manual.	Repair complete

STEP 3G: Check the load carrying capabilities of the ECM power and ground circuits.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness 60-pin ECM connector.

Action	Specification/Repair	Next Step
Connect a headlight (12 volt) to the OEM battery voltage supply pins. **Note:** A headlight **must** be used to make sure the wattage rating will put enough of a load on the circuit. **Note:** Make sure to use the appropriate test leads. The test leads can also be used to check for contact between the ECM power supply connector pins and the test leads. Resistance should be felt when removing the test leads from the ECM power supply connector pins. Use the ECM battery SUPPLY (+) pin in the OEM 60-pin ECM connection for the battery positive (+) and the ECM battery SUPPLY (-) pin in the OEM 60-pin ECM connector for the battery negative (-). Refer to the wiring diagram for connector pin identification.	Does the headlight illuminate brightly? **YES**	3H
	Does the headlight illuminate brightly? **NO** **Repair:** Determine the cause of the low ECM battery power supply. Check the battery connections and fuse terminals. If necessary, repair or replace the ECM power harness. • Refer to the OEM service manual.	Repair complete

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STEP 3H: Monitor the fuel rail pressure sensor value while cranking the engine.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine Cranking.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor Fuel Rail Pressure (Measured) and Fuel Rail Pressure (Commanded). • Attempt to start the engine; engage the engine starter for at least 30 continuous seconds. This allows the fault code logic time to run. • If Fault Code 559 becomes active, the necessary fuel rail pressure is **not** being developed to start the engine. **Note:** Do **not** overheat the starter. **Note:** If the engine starts during this attempt, it is possible the fuel prime to the high-pressure pump has been lost. Inspect for loose fuel lines that allow for loss of fuel prime. **Note:** In some vehicles, power to the electronic service tool is interrupted during cranking. In this case it is **not** possible to monitor fuel pressure during cranking. Fault Code 559 will increase in count after a failed start attempt if the fuel rail pressure is low.	Did Fault Code 559 become active during the unsuccessful start attempt? **YES** **Repair:** Find and repair the cause of low fuel pressure. Use Fault Code 559 troubleshooting tree.	Repair complete
	Did Fault Code 559 become active during the unsuccessful start attempt? **NO**	2A

STEP 4: Fuel system checks.

STEP 4A: Check for air entering the fuel system.

Condition:
- Refer to Procedure 006-003 in Section 6.

Action	Specification/Repair	Next Step
Check for air entering the fuel system. Refer to Procedure 006-003 in Section 6.	Is air present in the fuel system? **YES** **Repair:** Locate and correct the cause of air ingestion in the fuel supply system. Sources of air ingestion include: • Loose water separating fuel filter(s) • Loose fuel line fittings • Loose or cracked fuel tank stand-pipes • Restrictions in the fuel supply line(s) • Filter(s) that cause cavitation at high fuel flow rates.	Repair complete
	Is air present in the fuel system? **NO**	4B

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STEP 4B: Measure the fuel inlet restriction.

Condition:
- Refer to Procedure 006-020 in Section 6.

Action	Specification/Repair	Next Step
Measure the fuel inlet restriction. Refer to Procedure 006-020 in Section 6. **Note:** If the issue is intermittent (no start or engine shuts off unexpectedly) and no issues can be found while the engine is being serviced, there may be debris in the fuel system causing an intermittent restriction. Install a fuel filter minder, Fleetguard® Part Number 3892576s, at the connection between the OEM fuel supply lines and the engine. A fuel filter minder will capture the peak restriction in millimeters and inches of mercury. If the issue occurs again, the fuel filter minder can be checked to see if something on the OEM side is causing an intermittent high restriction.	Is the fuel inlet restriction within specification? **YES**	4C
	Is the fuel inlet restriction within specification? **NO** **Repair:** Find and correct the cause of the high fuel inlet restriction. Inspect for plugged OEM fuel filters or screens, pinched OEM fuel lines, or a restricted stand-pipe in the OEM fuel tank.	Repair complete

STEP 4C: Measure the lift pump fuel flow.

Condition:
- Refer to Procedure 005-236 in Section 5.

Action	Specification/Repair	Next Step
Measure lift pump fuel flow. Refer to Procedure 005-236 in Section 5.	Is the fuel pressure greater than specification? **YES**	4D
	Is the fuel pressure greater than specification? **NO** **Repair:** Replace the fuel lift pump. - Refer to Procedure 005-045 in Section 5.	Repair complete

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STEP 4D: Measure the fuel pressure at the inlet to the pressure side fuel filter.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Measure the fuel pressure at the inlet to the pressure side fuel filter. Refer to Procedure 005-236 in Section 5.	Is the pressure measured greater than the specification? **YES**	4E
	Is the pressure measured greater than the specification? **NO** **Repair:** Replace the fuel pump gear pump. • Refer to Procedure 005-025 in Section 5.	Repair complete

STEP 4E: Measure the fuel pressure at the outlet of the pressure side fuel filter.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Measure fuel pressure at the outlet of the pressure side fuel filter. • Refer to Procedure 005-236 in Section 5. • Calculate the pressure drop across the fuel filter by subtracting the pressure measured in this step from the pressure recorded in Step 4C. **Note:** If the engine will **not** start, measure the fuel pressure during engine cranking.	Is the fuel pressure drop across the filter greater than the specification? **YES** **Repair:** Replace the pressure side fuel filter. • Refer to Procedure 006-065 in Section 6.	Repair complete
	Is the fuel pressure drop across the filter greater than the specification? **NO**	4F

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STEP 4F: Measure the injector fuel drain flow.

Condition:
N/A

Action	Specification/Repair	Next Step
Measure the injector fuel drain flow from the cylinder head. • Refer to Procedure 005-236 in Section 5.	Is injector fuel drain flow from the cylinder head greater than specification? **YES** **Repair:** Continue troubleshooting to determine which cylinder(s) is/are causing excessive drain flow. • Refer to Procedure 005-236 in Section 5. Repair or replace the faulty component(s).	Repair complete
	Is injector fuel drain flow from the cylinder head greater than specification? **NO**	4G

STEP 4G: Monitor Commanded Fuel Rail Pressure and Measured Fuel Rail Pressure.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine idling.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to monitor Commanded Fuel Rail Pressure and Measured Fuel Rail Pressure while the engine is idling. **Note:** When monitoring, note whether any engine driven accessory (air conditioning compressor, air compressor, fan clutch, etc.) turns on. Also, note whether any of the accessories that put a demand/ load on the alternator (intake air heater, vehicle accessories, etc.). These items can affect the outcome of this check. The load on the engine should be constant.	Does the Measured Fuel Rail Pressure vary more than ± 35 bar [± 500 psi] from the Commanded Fuel Rail Pressure? **YES** **Repair:** Replace the fuel pump actuator. • Refer to Procedure 019-117 in Section 19.	Repair complete
	Does the Measured Fuel Rail Pressure vary more than ± 35 bar [± 500 psi] from the Commanded Fuel Rail Pressure? **NO**	4H

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STEP 4H: Check the fuel pressure relief valve for excessive leakage.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Measure the fuel pressure relief valve drain flow. Refer to Procedure 005-236 in Section 5.	Is the fuel pressure relief valve within specification? **YES**	4I
	Is the fuel pressure relief valve within specification? **NO** **Repair:** Replace the fuel pressure relief valve. • Refer to Procedure 006-061 in Section 6.	Repair complete

STEP 4I: Measure the fuel pump head drain flow.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Measure the fuel pump head drain flow. Refer to Procedure 005-236 in Section 5.	Is the high-pressure fuel pump head drain flow greater than specification? **YES** **Repair:** Replace the fuel pump head. • Refer to Procedure 005-227 in Section 5.	Repair complete
	Is the high-pressure fuel pump head drain flow greater than specification? **NO**	4J

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STEP 4J: Check the fuel drain line restriction.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Check the fuel drain line restriction. Refer to Procedure 006-012 in Section 6.	Is the drain line restriction greater than specification? **YES** **Repair:** Check the OEM fuel drain lines to the tank for proper size, leaks, bends, and clogs. Check the fuel tank vents for plugging.	Repair complete
	Is the drain line restriction greater than specification? **NO** **Repair:** Perform the next troubleshooting procedure as outline in Step 2.	2A

STEP 5: Air handling checks.

STEP 5A: Check the air intake system for leaks.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Check the air intake system for leaks. Refer to Procedure 010-024 in Section 10. **Note:** On engines equipped with a turbocharged air compressor, one often overlooked item as a source of air leaks is the air compressor intake line. The intake line supplies intake air from the intake of the engine to the air compressor.	Were any air intake system leaks found? **YES** **Repair:** Repair or replace the damaged component.	Repair complete
	Were any air intake system leaks found? **NO**	5B

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STEP 5B: Check air intake restriction.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Check the air intake restriction. Refer to Procedure 010-031 in Section 10.	Is the air intake restriction greater than the specification? **YES** **Repair:** Correct the cause of high intake air restriction. Check for a plugged air filter or restricted air intake piping. • Refer to the OEM service manual.	Repair complete
	Is the air intake restriction greater than the specification? **NO**	5C

STEP 5C: Inspect charge-air cooler.

Condition: • Engine OFF.		
Action	**Specification/Repair**	**Next Step**
Inspect the charge-air cooler for cleanliness, cracks, holes, or other damage. Refer to Procedure 010-027 in Section 10. The pressure test and the temperature differential test can be used to verify charge-air cooler problems.	Were any problems found with the charge-air cooler? **YES** **Repair:** Repair or replace the charge-air cooler assembly. • Refer to Procedure 010-027 in Section 10.	Repair complete.
	Were any problems found with the charge-air cooler? **NO**	5D

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STEP 5D: Inspect the turbocharger shaft movement.

Condition:
- Turn keyswitch OFF.
- Remove the variable geometry turbocharger actuator from the turbocharger.

Action	Specification/Repair	Next Step
Inspect the sector gear on the turbocharger for damaged or broken gear teeth. Move the sector gear lever on the turbocharger bearing housing up and down from stop to stop. Check for smooth movement between the stops. There will be an initial friction force that **must** be overcome before the actuator lever will move. Once movement is started, the actuator lever should move to the other stop position by hand. Refer to Procedure 010-134 in Section 10.	Does the nozzle slide evenly from stop to stop and are the gear teeth undamaged? **YES** **Repair:** Install the turbocharger actuator. • Refer to Procedure 010-134 in Section 10.	5E
	Does the nozzle slide evenly from stop to stop and are the gear teeth undamaged? **NO** **Repair:** A turbocharger mechanical malfunction has been detected. **Note:** This malfunction could have been caused by debris exiting the engine, causing the turbocharger nozzle to stop moving. Inspect the base engine components for damage. If necessary, replace the turbocharger assembly. • Refer to Procedure 010-033 in Section 10.	Repair complete.

STEP 5E: Inspect the turbocharger blades for damage or fouling.

Condition:
- Engine OFF.
- Disconnect the exhaust and intake connections from the turbocharger.

Action	Specification/Repair	Next Step
Inspect the compressor and turbine fins for damage or fouling. Refer to Procedure 010-033 in Section 10.	Damage or fouling found on the turbocharger fins? **YES** **Repair:** Replace the turbocharger. • Refer to Procedure 010-033 in Section 10.	Repair complete
	Damage or fouling found on the turbocharger fins? **NO**	5F

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STEP 5F: Measure turbocharger axial and radial clearance.

Condition:
- Engine OFF.
- Disconnect the exhaust and intake connections from the turbocharger.

Action	Specification/Repair	Next Step
Measure the radial and axial clearance of the turbocharger. Refer to Procedure 010-033 in Section 10.	Were the radial and axial clearances within specification? **YES** **Repair:** Perform the next troubleshooting procedure as outlined in Step 2.	2A
	Were the radial and axial clearances within specification? **NO** **Repair:** Replace the turbocharger assembly. • Refer to Procedure 010-033 in Section 10.	Repair complete

STEP 6: EGR system checks.

STEP 6A: Check for leaks in the EGR system.

Condition:
- Turn keyswitch ON.
- Start the engine and let it idle.

Action	Specification/Repair	Next Step
Check for leaks in the EGR system. Refer to Procedure 010-024 in Section 10. Check the following: • Connection tubing and V-band connections • Mounting flange for the differential pressure sensor. **Note:** Soot streaks will be noticeable where leaks are present.	Were air leaks found in the EGR connection tubing? **YES** **Repair:** Repair any leaks or damaged components in the EGR system.	Repair complete
	Were air leaks found in the EGR connection tubing? **NO**	6B

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STEP 6B: Check the EGR differential pressure sensor for proper operation.

Condition:
- Turn keyswitch ON.
- Start the engine.
- INSITE™ electronic service tool connected.

Action	Specification/Repair	Next Step
Operate the engine until the EGR valve opens. • Use INSITE™ electronic service tool to monitor the EGR differential pressure sensor and EGR valve position at idle conditions. • If the EGR valve position is at 0 percent open, the engine is actively regenerating. The active regeneration **must** complete before this step can be performed. To expedite this, perform a stationary regeneration. Refer to Procedure 014-013 in Section 14. **Note:** The EGR valve may **not** open until the engine has reached normal operating temperature.	Is the EGR differential pressure greater than 1.5 kPa [0.22 psi] when the EGR valve is open greater than 50 percent? **YES**	6E
	Is the EGR differential pressure greater than 1.5 kPa [0.22 psi] when the EGR valve is open greater than 50 percent? **NO**	6C

STEP 6C: Check the EGR system for blockage.

Condition:
- Turn keyswitch OFF.
- Remove the EGR valve differential pressure sensor.

Action	Specification/Repair	Next Step
Inspect the passages in the sensor and in the EGR mass measurement flow assembly for blockage or excessive carbon build up. Refer to Procedure 019-370 in Section 19.	Was blockage or excessive carbon buildup found in the EGR valve differential pressure sensor and/or EGR mass measurement flow assembly passages? **YES** **Repair:** Clean the passages in the sensor and in the EGR mass measurement flow assembly. If the blockage or carbon buildup is too severe, replace the EGR valve differential pressure sensor and/or the EGR mass measurement flow assembly. • Refer to Procedure 019-370 in Section 19.	Repair complete
	Was blockage or excessive carbon buildup found in the EGR valve differential pressure sensor and/or EGR mass measurement flow assembly passages? **NO**	6D

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STEP 6D: Check the EGR valve for blockage and/or damage.

Condition:
- Turn keyswitch OFF.
- Remove the EGR valve. 011-022 in Section 11.

Action	Specification/Repair	Next Step
Inspect the EGR valve flow area for carbon buildup, corrosion, and/or a stuck open valve.	Is the EGR valve blocked and/or damaged? **YES** **Repair:** Replace the EGR valve, if necessary. • Refer to Procedure 011-022 in Section 11.	Repair complete
	Is the EGR valve blocked and/or damaged? **NO**	6E

STEP 6E: Check the exhaust gas pressure sensor plumbing for blockage.

Condition:
- Turn keyswitch OFF.
- Disconnect the exhaust gas pressure sensor plumbing. Refer to Procedure 011-027 in Section 11.

Action	Specification/Repair	Next Step
Check for condensation or foreign material buildup. • Clean or replace any of the removed components as necessary.	Was there blockage in the exhaust pressure sensor plumbing? **YES** **Repair:** Clean or replace the blocked exhaust pressure sensor plumbing. • Refer to Procedure 011-027 in Section 11.	Repair complete
	Was there blockage in the exhaust pressure sensor plumbing? **NO** **Repair:** Perform next troubleshooting procedure as outlined in Step 2.	2A

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STEP 7: Verify electronic features are operating properly correctly.

STEP 7A: Verify the electronic feature settings are correct.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to verify the following adjustable parameters are correctly set per the vehicle or customer requirements: • Alternator Failure Warning • Cruise Control - Cruise Control Lower Droop • Cruise Control - Cruise Control Upper Droop • Cruise Control - Maximum Cruise Control Speed • Fast Idle Warm-up • Gear-down protection • Governor Type • Idle Shutdown • Powertrain Protection • PTO - Maximum Engine Load • Road Speed Governor - Maximum Accelerator Vehicle Speed • Road Speed Governor - Maximum Vehicle Speed • Road Speed Governor - Road Speed Governor Lower Droop • Road Speed Governor - Road Speed Governor Upper Droop • Transmission Setup - Transmission Type • Vehicle Acceleration Management • Vehicle Speed Source - Number of Transmission Tailshaft Gear Teeth • Vehicle Speed Source - Rear Axle Ratio • Vehicle Speed Source - Tire Size.	Were the electronic features set correctly? **YES** **Repair:** Perform the next troubleshooting procedure as outlined in Step 2.	2A
	Were the electronic features set correctly? **NO** **Repair:** Use INSITE™ electronic service tool to correct the programmable features.	Repair complete

STEP 8: Perform base engine mechanical checks.

STEP 8A: Verify the symptom is "Engine Will Not Start".

Condition:
- Turn keyswitch ON.
- Start cranking the engine.

Action	Specification/Repair	Next Step
Verify the engine symptom is Engine Will Not Start.	Does the engine start and run? **YES**	8B
	Does the engine start and run? **NO**	8D

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STEP 8B: Verify overhead adjustments are correct.

Condition:
- Turn keyswitch OFF.
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3.

Action	Specification/Repair	Next Step
Check the overhead setting. • Refer to Procedure 003-004 in Section 3.	Were the overhead settings within the reset limits? **YES**	8C
	Were the overhead settings within the reset limits? **NO** **Repair:** Adjust the overhead settings. • Refer to Procedure 003-004 in Section 3.	Repair complete

STEP 8C: Check engine blowby (crankcase pressure).

Condition:
N/A

Action	Specification/Repair	Next Step
Check engine blowby (crankcase pressure). Refer to Procedure 014-010 in Section 14.	Is the blowby (crankcase pressure) greater than specification? **YES** **Repair:** Determine which component is contributing to engine blowby (crankcase pressure). • Refer to Procedure 014-010 in Section 14. Repair as necessary.	Repair complete
	Is the blowby (crankcase pressure) greater than specification? **NO**	8D

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STEP 8D: Check for internal engine damage.

Condition:
- Engine OFF.

Action	Specification/Repair	Next Step
Remove the oil filter. • Refer to Procedure 007-013 in Section 7. Cut the lubricating oil filter open and inspect for evidence of internal engine damage. • Refer to Procedure 007-083 in Section 7.	Did cutting the oil filter open reveal evidence of internal engine damage? **YES** **Repair:** Determine the area of probable damage and repair as necessary. Remove the lubricating oil pan and rocker lever cover and inspect the engine for damage. • Refer to Procedure 007-025 in Section 7. • Refer to Procedure 003-011 in Section 3.	Repair complete
	Did cutting the oil filter open reveal evidence of internal engine damage? **NO** **Repair:** Verify the engine symptom.	Repeat any necessary troubleshooting steps.

STEP 9: Perform exhaust system checks.

STEP 9A: Inspect the exhaust system.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Inspect the exhaust system between the turbocharger outlet and aftertreatment inlet for leaks. Refer to Procedure 010-024 in Section 10.	Were any exhaust leaks found in the exhaust system? **YES** **Repair:** Repair any leaks or damaged components. • Refer to the OEM service manual.	Repair complete
	Were any exhaust leaks found in the exhaust system? **NO**	9B

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STEP 9B: Check the exhaust restriction.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Check the exhaust restriction. Refer to Procedure 011-009 in Section 11.	Is the exhaust restriction greater than specification? **YES**	9C
	Is the exhaust restriction greater than specification? **NO** **Repair:** Perform the next troubleshooting procedure as outline in Step 2.	2A

STEP 9C: Check exhaust restriction after the aftertreatment diesel particulate filter.

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Check the exhaust restriction after the diesel particulate filter. Refer to Procedure 011-009 in Section 11.	Is the exhaust restriction greater than specification? **YES** **Repair:** Check the aftertreatment SCR system for crystallization or deposits. • Refer to Procedure 011-064 in Section 11.	Repair complete
	Is the exhaust restriction greater than specification? **NO** **Repair:** Perform a Stationary Regeneration. • Refer to Procedure 014-013 in Section 14.	Repair complete

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